NEVARC NEWS

VK3ANE

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The monthly magazine of the

North East Victoria Amateur Radio Club http://nevarc.org.au/

An affiliated club of the Wireless Institute of Australia

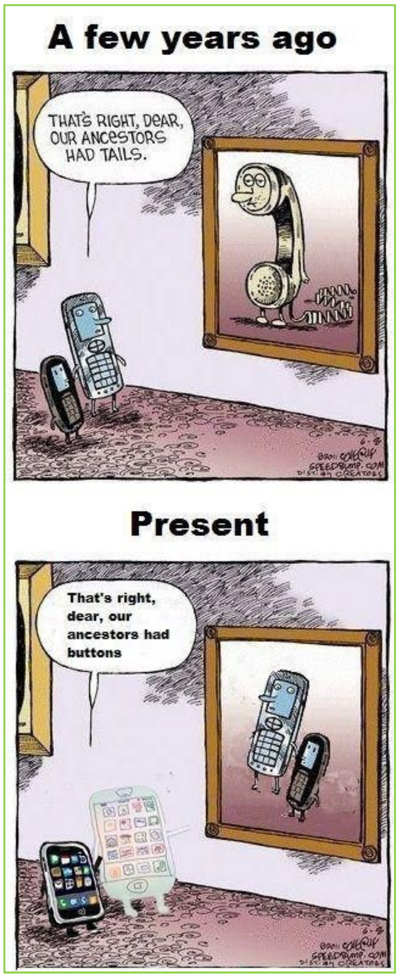
Volume No: 06 Issue 1 January 2019

Next Club Meeting Details Will be posted on club website

Latest meeting details found on club website at

http://nevarc.org.au/

along with past and current newsletter issues



NEVARC Christmas BBQ Gathering

Last meeting was hosted by Matt and Amy at their home as the hall was not available.
A dozen or so members took up the offer of a feed and social catch up.
As predicated and promised by both Matt and Amy, the food was well "over catered" and plenty was on offer for all to feast on.
Even the sausages were home made by Samantha, an entire plate of them stacked high.

Matt on BBQ duty

Various items of radio equipment were on display in the rear yard including some rare 11 meter CBs Brenton sourced from the states. More updates on the NEVARC repeaters were informed to the group, another update by Matt in a future article in this newsletter will be done once all is sorted.

Mick VK3CH thought the Hume Freeway might still be a pond, but all the water had subsided and the trip from Melbourne was incident free, quite pleasant weather for what is usually a sunburnt season.

The nibbles, before Mick got to it →

Vintage 11mx rigs

The Luncheon in full swing

Dessert… yummy

Brenton with the "VK3CM" vehicle

Thanks to all who brought food and all the preparation and the hosting by Matt and Amy.

NEVARC AGM Results

The AGM was held last meeting and the following were elected to help run the club for the next year ahead.

Executive Committee:

President, VK2VU, Gary
Vice President, Vacant
Secretary, VK2FKLR, Kathleen
Treasurer, Amy

Committee Members:

VK3AHR, Ron
VK3NWH, Nigel
VK3CH, Mick

Website Manager, VK3VS, Matt

NEVARC News Editor, VK3CH, Mick

Summer VHF /UHF Field Day - Saturday 12 Sunday 13 January

John Moyle Field Day - March 17 and 18

20th Harry Angel Memorial Sprint - May 4

Trans-Tasman Low-Band Contest - July 20

VK Remembrance Day Contest - August 17-18

China, Russia reveal secret test to ‘heat’ atmosphere and jam signals such as GPS

No GPS? No satellite TV? No radar? Russia and China say they have found ways to boost their own signals — and jam others.

Northern European nations have this year been complaining of unexplained ‘outages’ of vital GPS systems. Now we know it was actually a secret experiment with the Chinese to modify the Earth’s atmosphere — to boost and jam vital signals.
Scientists have revealed the existence of the project in a research paper published in the Chinese journal *Earth and Planetary Physics*.

According to the South China Morning Post, it describes how a specific layer of the Earth’s atmosphere over Europe was ‘modified’ to test the military application of the technology.
The interaction of the sun and cosmic rays with Earth’s atmosphere and magnetic sphere creates a variable layer of free-floating, positively charged ions some 75km to 1000km above the surface. This layer reflects radio waves, enabling transmissions such as short-wave radio and some radars to travel long distances.

The over-the-horizon radar project at Jindalee

A powerful array of microwave antennas in Russia has been used to ‘heat’ the ionosphere, causing signals from GPS satellites to be jammed. Depending on its state due to ‘space weather’ — such as solar storms — it can also serves as a barrier to signals attempting to pass through it. “The militaries have been in a race to control the ionosphere for decades,” the South China Morning Post asserts.
Reportedly, a 500km-high portion of the ionosphere was ‘heated’ five times in June. One test, on June 7, caused some 126,000 sqkm of the sky — roughly equivalent to half the size of Britain — to flare with energy.

Whether or not similar experiments caused a series of GPS failures during NATO’s Trident Juncture military exercise in the North Atlantic in October and November is not known.
An ex Soviet Union facility near the central Russian town of Vasilsurk was modified for the test. Called Sura, the array of high-power transmitting towers pumped microwaves high into the sky.
At its peak output of 260 megawatts (enough for a small city), it was reportedly able to manipulate the temperature of a thin layer of ionised gas in the outer reaches of our atmosphere by up to 100C.

The effect of the Russian transmitters was measured by a Chinese electromagnetic surveillance satellite, Zhangheng-1.
The research team reported the results to be “satisfactory”.
It states even relatively low outputs of microwave power could create large ‘abnormalities’ in the ionosphere. But it was only effective at night, as the sun’s influence quickly overwhelmed the artificial output.

“The detection of plasma disturbances … provides evidence for likely success of future related experiments,” the study reads.
The Post adds: “High-energy microwaves can pluck the electromagnetic field in ionosphere like fingers playing a harp. This can produce very low-frequency radio signals that can penetrate the ground or water — sometimes to depths of more than 100 metres in the ocean, which made it a possible communication method for submarines.”

Russia is not the only nation with such technology. The United States operates a similar array in Alaska. Australia’s Jindalee/JORN over-the-horizon radar system also relies on the ionosphere to bounce signals back and forth.
China is now reportedly building a larger transition array in Sanya, Hainan, “with capability to manipulate the ionosphere over the entire South China Sea”.

~Internet

'Internet of things' nears as spectrum sale raises $853m

The much-anticipated auction of the 3.6 GHz spectrum band has ended with the federal government getting a little less than it might have hoped but achieving the competitive outcomes it sought.

With Telstra paying $386 million for 143 5MHz lots, the Vodafone/TPG joint venture bidding vehicle $263.3 million for 131 lots, Optus $185 million for 47 lots and the UK-based technology business Dense Air $18.5 million for 29 lots, the government has raised $852 million from the auction.

While the average price of 29 cents per MHz per head of population is up there with the highest prices for 5G spectrum paid anywhere in the world, the total proceeds fell short of the $1 billion-plus once speculated.

That's because Communications Minister Mitch Fifield prioritised competition over the maximisation of the revenue to the government, allowing Vodafone and TPG to bid jointly, before their planned merger has been approved or concluded, and in effect precluding Optus from bidding for spectrum in Sydney and Melbourne.

The scarcity of the available 3.5 GHz spectrum shaped the auction. Ostensibly, there was 300 MHz available but Optus already held about 100 MHz that it picked up when it acquired Vividwireless in 2012 and NBN Co had 75 MHz reserved for its fixed wireless services in 2015. That left only 125 MHz available.

By imposing "caps'' on bidding of 60 MHz in the metropolitan areas and 80 MHz in regional areas – in effect shutting Optus and NBN Co out of the auctions for spectrum in Sydney and Melbourne – Fifield ensured Telstra and the Vodafone/TPG combination could get their hands on sufficient spectrum to deliver 5G services.

Both Telstra (which had some pre-existing spectrum in the smaller capitals and regions) and Vodafone bought the maximum amount of spectrum allowed in Sydney and Melbourne, with Telstra saying it now had 60 MHz of contiguous 5G spectrum in all the major capital cities and between 50 and 80 MHz of spectrum in all regional areas.

While there is still next year's auction of spectrum in the 26 GHz band to come - spectrum that could have some 5G applications in urban areas - the 3.6 GHz spectrum auction outcomes mean all three of the wireless carriers (assuming the merger of Vodafone and TPG does get regulatory clearance) have enough bandwidth to deliver strong 5G services.

A 5G network offers exciting possibilities but a lot needs to happen before Australia experiences its full effect.

The speeds and ultra-low latency of 5G networks open up a vast range of possible new applications, from autonomous vehicles and drone deliveries to augmented reality and, for households and businesses, the "internet of things.''

The networks will be dramatically more efficient than existing wireless networks and, because they will drive more data usage and enable new applications that create revenue streams that don't exist today, should generate more revenue.

Lower costs and higher average revenues per user offer the potential for the sector to emerge from a very tough period where the roll-out of the national broadband network has seen an escalation of price-driven competition and a gutting of fixed-line revenues and profits that has destabilised Telstra and others, like TPG, selling fixed-line services.

The investment in 5G networks – for the spectrum and the infrastructure - is substantial but they do have the potential to be quite transformative and not just for the telcos.

The European Commission has estimated that it would require an investment of about €500 billion ($800 billion) by 2025 to achieve its connectivity objectives. It would add about €910 billion ($1.44 trillion) to the eurozone's GDP and create more than 2 million jobs.

In most markets around the world, 5G services are expected to be launched in 2020.

That's the case here, too. The spectrum licences acquired in the auction don't start until March 2020, although the Australian Communications and Media Authority, which manages spectrum allocations, has said there are arrangements that could enable earlier access to the band, provided no interference was caused to any existing licensees.

Telstra, which held an investor day devoted to its 5G plans last week, has already completed 130 5G-enabled sites and plans to have 200 of them by the end of this year. Optus and Vodafone/TPG are also planning and preparing for the upgrading of their networks by 2020, albeit perhaps without quite the same urgency that Telstra is demonstrating.

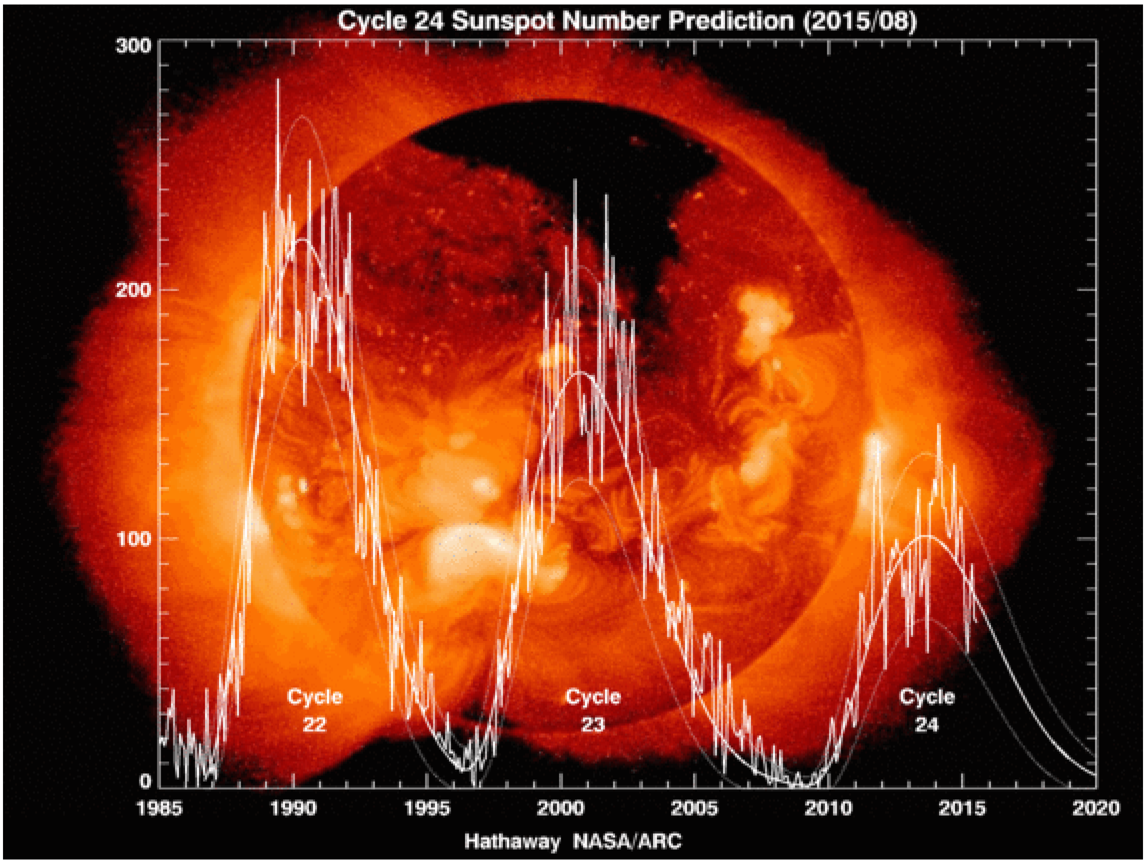
There aren't yet the 5G-compatible handsets and devices that would confer any big advantage from early completion of the infrastructure build, although Telstra has said that as it is upgrading the core of its network in preparing for a 5G environment, it is seeing improvements in 4G speeds.

Protecting its market leadership in wireless is a key element of its Telstra2022 strategy, which will see all of its infrastructure other than that supporting the wireless business hived off into a separate vehicle that could be sold or demerged.

~Internet

Waiting For The Next Sunspot Cycle: 2019-2030

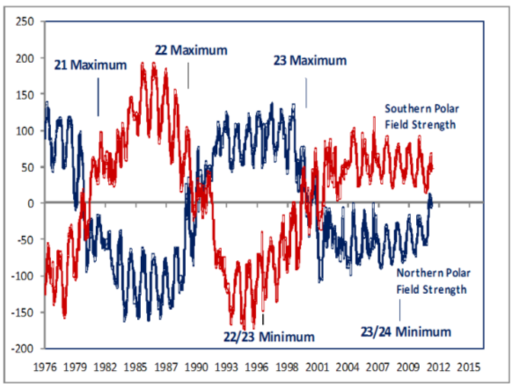
Ever since Samuel Schwabe discovered the 11-year ebb and flow of sunspots on the sun in 1843, predicting when the next sunspot cycle will appear, and how strong it will be, has been a cottage industry among scientists and non-scientists alike. For solar physicists, the sunspot cycle is a major indicator of how the sun's magnetic field is generated, and the evolution of various patterns of plasma circulation near the solar surface and interior. Getting these forecasts bang-on would be proof that we indeed have a 'deep' understanding of how the sun works that is a major step beyond just knowing it is a massive sphere of plasma heated by thermonuclear fusion in its core.



So how are we doing?

For over a century, scientists have scrutinized the shapes of dozens of individual sunspot cycles to glean features that could be used for predicting the circumstances of the next one. Basically, we know that 11-years is an average and some cycles are as short as 9 years or as long as 14. The number of sunspots during the peak year, called sunspot maximum, can vary from as few as 50 to as many as 260. The speed with which sunspot numbers rise to a maximum can be as long as 80 months for weaker sunspot cycles, and as short as 40 months for the stronger cycles. All of these features, and many other statistical rules-of-thumb, lead to predictive schemes of one kind or another, but they generally fail to produce accurate and detailed forecasts of the 'next' sunspot cycle.

Prior to the current sunspot cycle (Number 24), which spans the years 2008-2019, NASA astronomer Dean Pesnell collected 105 forecasts for Cycle 24. For something as simple as how many sunspots would be present during the peak year, the predictions varied from as few as 40 to as many as 175 with an average of 106 +/-31. The actual number at the 2014 peak was 116. Most of the predictions were based on little more than extrapolating statistical patterns in older data. What we really want are forecasts that are based upon the actual physics of sunspot formation, not statistics. The most promising physics-based models we have today actually follow magnetic processes on the surface of the sun and below and are called Flux Transport Dynamo models.



The sun's magnetic field is much more fluid than the magnetic field of a toy bar magnet. Thanks to the revolutionary work by helioseismologists using the SOHO spacecraft and the ground-based GONG program, we can now see below the turbulent surface of the sun. There are vast rivers of plasma wider than a dozen Earths, which wrap around the sun from east to west. There is also a flow pattern that runs north and south from the equator to each pole. This meridional current is caused by giant convection cells below the solar surface and acts like a conveyor belt for the surface magnetic fields in each hemisphere. The sun's north and south magnetic fields can be thought of as waves of magnetism that flow at about 60 feet/second from the equator at sunspot maximum to the poles at sunspot minimum, and back again to the equator at the base of the convection cell. At sunspot minimum they are equal and opposite in intensity at the poles, but at sunspot maximum they vanish at the poles and combine and cancel at the sun's equator. The difference in the polar waves during sunspot minimum seems to predict how strong the next sunspot maximum will be about 6 years later as the current returns the field to the equator at the peak of the next cycle. The forecasts suggest Cycle 25 might continue the declining trend of polar field decrease seen in the last three sunspot cycles, and be even weaker than Cycle 24 with far fewer than 100 spots.

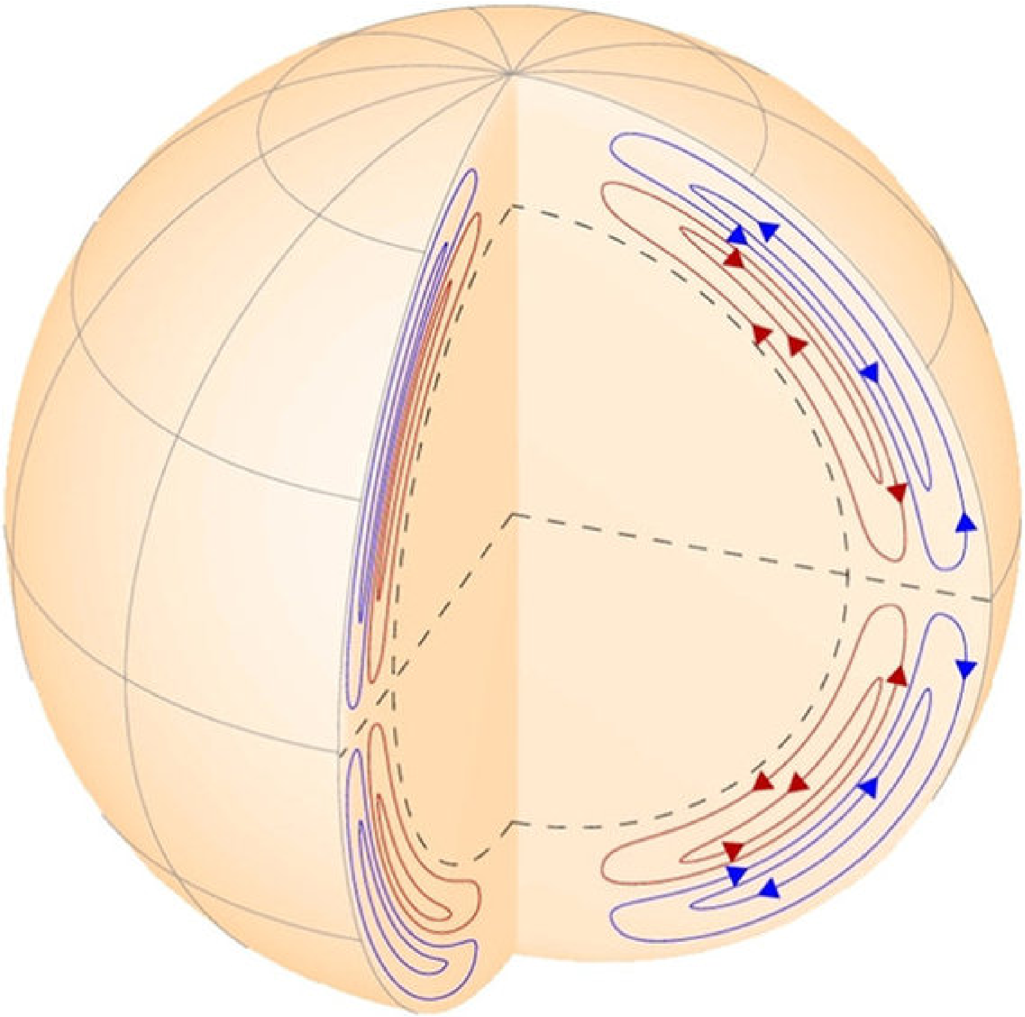


Figure showing the meridional circulation patterns on the sun

So what can we bank on?

Statistically speaking, the current Cycle 24 is scheduled to draw to a close about 11 years after the previous sunspot minimum in January 2008, which means sometime in 2019. We entered the Cycle 24 sunspot minimum period in 2016 because in February and June, we already had two spot-free days. As the number of spot-free days continues to increase in 2017-2018, we will start seeing the new sunspots of Cycle 25 appear sometime in late-2019. Sunspot maximum is likely to occur in 2024, with most forecasts predicting about half as many sunspots as in Cycle 24.

The bad news is that some studies show sunspot magnetic field strengths have been declining since 2000 and are already close to the minimum needed to sustain sunspots on the solar surface. This is also supported by independent work in 2015 published in the journal Nature. By Cycle 25 or 26, magnetic fields may be too weak to punch through the solar surface and form recognizable sunspots at all, spelling the end of the sunspot cycle phenomenon, and the start of another Maunder Minimum cooling period perhaps lasting until 2100.

But the good news seems to be that none of the current forecasts suggest Cycle 25 will be entirely absent. A few forecasts even hold out some hope that a sunspot maximum equal to or greater than Cycle 24 is possible.

~Internet

PREDICTIONS OF THE FUTURE OF TECH

1. "With over fifteen types of foreign cars already on sale here, the Japanese auto industry isn't likely to carve out a big share of the market for itself." -- *Business Week*, 1968.

2. "Lee DeForest has said in many newspapers and over his signature that it would be possible to transmit the human voice across the Atlantic before many years. Based on these absurd and deliberately misleading statements, the misguided public ... has been persuaded to purchase stock in his company ..." -- a U.S. District Attorney, prosecuting American inventor Lee DeForest for selling stock fraudulently through the mail for his Radio Telephone Company in 1913.

3. "To place a man in a multi-stage rocket and project him into the controlling gravitational field of the moon where the passengers can make scientific observations, perhaps land alive, and then return to earth - all that constitutes a wild dream worthy of Jules Verne. I am bold enough to say that such a man-made voyage will never occur regardless of all future advances." -- Lee DeForest, American radio pioneer and inventor of the vacuum tube, in 1926.

4. "Heavier-than-air flying machines are impossible." -- Lord Kelvin, British mathematician and physicist, president of the British Royal Society, 1895.

5. "Nuclear-powered vacuum cleaners will probably be a reality in 10 years." - Alex Lewyt, president of vacuum cleaner company Lewyt Corp., in the *New York Times* in 1955.

6. "There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will." -- Albert Einstein, 1932.

7. "The cinema is little more than a fad. It's canned drama. What audiences really want to see is flesh and blood on the stage." -- Charlie Chaplin, actor, producer, director, and studio founder, 1916.

8. "The Americans have need of the telephone, but we do not. We have plenty of messenger boys." -- Sir William Preece, Chief Engineer, British Post Office, 1878.

9. "The world potential market for copying machines is 5,000 at most." -- IBM, to the eventual founders of Xerox, 1959.

10. "How, sir, would you make a ship sail against the wind and currents by lighting a bonfire under her deck? I pray you, excuse me; I have not the time to listen to such nonsense." -- Napoleon Bonaparte, when told of Robert Fulton's steamboat.

11. "[Television] won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a plywood box every night." -- Darryl Zanuck, movie producer, 20th Century Fox, 1946.

12. "When the Paris Exhibition [of 1878] closes, electric light will close with it and no more will be heard of it." -- Oxford professor Erasmus Wilson.

RCA (Radio Corporation of America)

One of the largest and most influential electronics companies during the 20th century was the Radio Corporation of America, or RCA. At one time, the breadth of its operations included everything from making vinyl records to building and manufacturing communications satellites.

RCA began life as a joint venture between several different manufacturers of electric equipment. In the early 1900s many companies began manufacturing and selling a new technology called radio. By about 1915 there were several radio stations operating in the U.S, but several of them were foreign owned and nearly all were used exclusively for transmitting Morse Code. When the U.S entered World War I, the federal government seized the foreign stations, and later gave them to the U.S companies General Electric (GE), Westinghouse, the American Telephone and Telegraph Company (AT&T) and United Fruit (an international shipping company). These companies set up a new organization in 1919 to run the stations, and called it the Radio Corporation of America (RCA).

For a time, RCA operated radio stations (still almost entirely used for transmitting Morse Code) and sold radio equipment manufactured by its parent companies. However, many amateur operators were now on the air and the resulting popularity of radio listening encouraged the parent companies to move in this direction. Westinghouse obtained a license from the U.S government to launch a commercial broadcasting station in 1920 and launched KDKA, the first commercial radio station. By 1926, the success of KDKA led RCA, Westinghouse, and General Electric to create a chain or “network” of radio stations spread across a wide geographic area, all broadcasting content created in central studios in New York. The name of this network was the National Broadcasting Corporation—NBC.

In 1929, RCA purchased phonograph manufacturer Victor Talking Machine Company, and renamed its new division RCA-Victor. With Victor’s expertise and facilities, RCA-Victor was able to begin making its own radio receivers (as well as records and phonographs), and quickly became one of the largest consumer electronics manufacturers. While the Great Depression of the 1930s crippled businesses worldwide, RCA-Victor and NBC thrived. NBC became such a big money maker that David Sarnoff, the leader of RCA, moved the headquarters to a huge new skyscraper in New York and created Radio City Music Hall, a large and technologically innovative performance space.

RCA’s major technical accomplishment in the 1930s was the development of the electronic television system that is still used in many parts of the world today (although it may soon be replaced by High Definition Television). Following a ten-year, millions-of-dollars research effort, led by Vladimir Zworykin, TV was demonstrated at the 1939 World’s Fair in New York and briefly sold to the public before it was put aside during World War II.

The huge research effort necessary for television encouraged the company to create a permanent research facility. When World War II came, RCA had a perfect opportunity to do so and opened its new RCA Research Laboratories in Princeton, New Jersey and produced many crucial innovations for the war effort. After the war RCA returned its attention to television, designing inexpensive receivers and sponsoring the creation of a new NBC television network to provide programming. RCA’s original television system, as well as the color television system it announced in the 1950s, would eventually prove to be the company’s most profitable line of products.

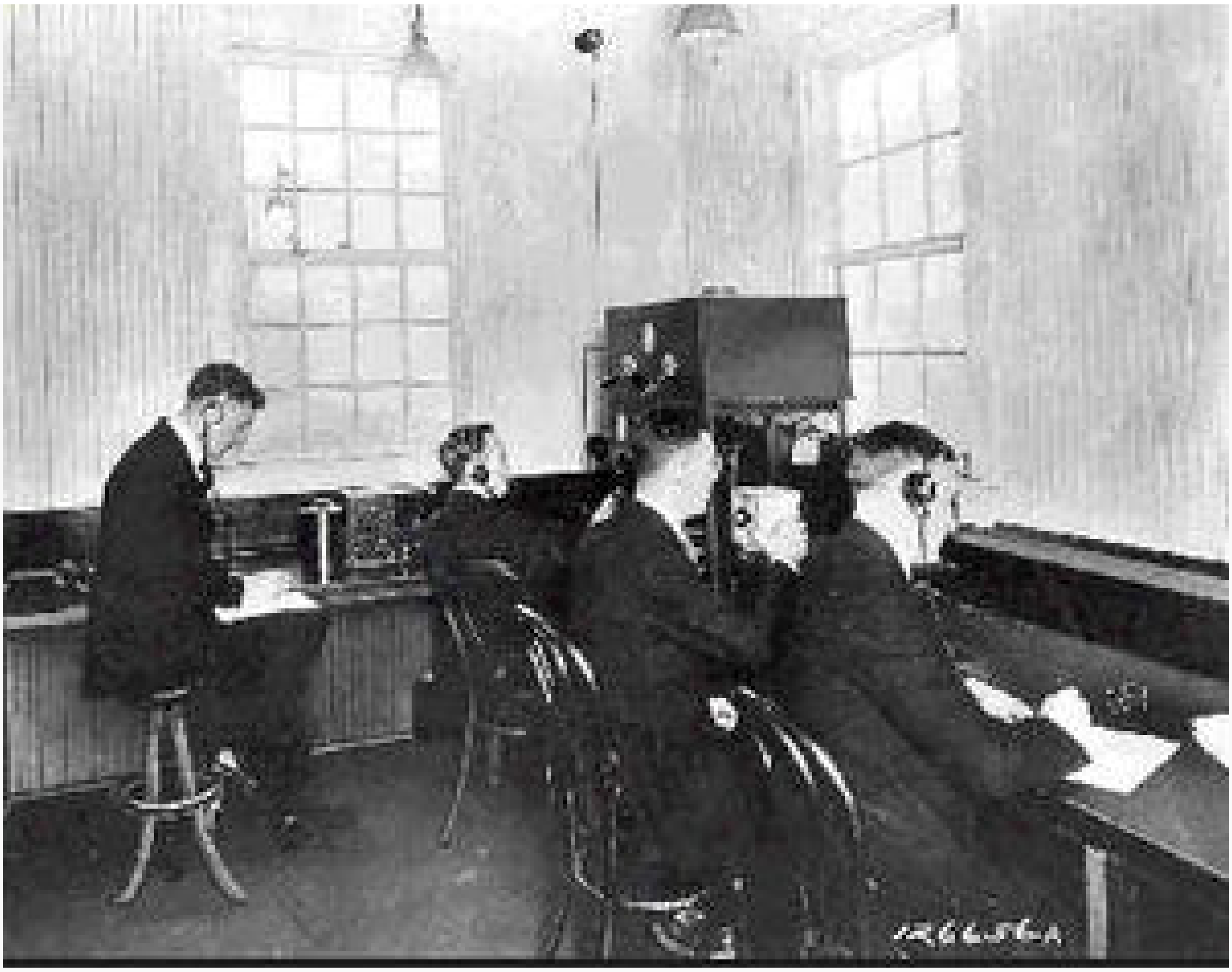
The period from the 1950s and 1970s saw both high and low points in RCA’s history. Its research laboratories produced innovative technologies in these years and helped advance computers, integrated circuits, lasers, and other devices. It introduced innovative products like the 45-rpm record and the solid-state television camera. Even some of the company’s minor innovations were very successful, such as the “RCA connector jack” found on many types of audio equipment. However, the company was finding it increasingly difficult to sell its traditional line of products. By the 1970s Asian firms had captured almost all of the consumer electronics market (TVs, radios, etc.). Corporate managers found that is was cheaper to sell foreign-made products in the U.S than to make them at home, so by the 1970s most RCA-branded consumer products were made of Asian parts, or were assembled outside the U.S. By the 1970s, virtually the only U.S-made RCA consumer electronics products were color televisions, and eventually these sales were lost, too.

RCA’s difficulties led to continual changes in its leadership, which negatively impacted business and contributed to RCA’s decline. The company’s inability to “follow through,” for example, led to the failure of its innovative videodisc player, the “Selectavision,” which could have become a competitor to the Betamax and VHS videotape systems. But due to poor management, it was brought to the market too late.

By 1986 RCA was so weak that it’s rival (and former co-owner) GE bought the company and dismantled it, selling off most of its parts, including the RCA name and the consumer electronics business. Today, the RCA name is owned by Thomson, a French company, while the German conglomerate, Bertelsmann, owns the RCA record division. The corporate headquarters was moved to Indianapolis, where RCA had once operated a large manufacturing facility. Today, Thomson manufactures consumer electronics in a variety of countries and sells them under the RCA and GE names.

~Internet

KDKA, First Commercial Radio Station



From Guglielmo Marconi's earliest successful radio demonstrations, which consisted of point-to-point sending of telegraph signals in Morse Code, it was clear to many that radio should be a broadcast medium. That is, rather than two people using it to talk back and forth like a telephone, one person could send out a signal that could be heard by many, like an actor speaking lines in a big auditorium. On Christmas Eve 1906, Reginald Fessenden broadcast a program with speech and music to an audience of amateurs and ship radio operators who had been previously alerted to tune in. Subsequently, many amateurs would broadcast entertainment and news, either by telling their friends in advance or just sending it out on the airwaves and letting it find whoever happened to tune in. During World War I, these amateurs were asked to suspend their operations, but many went back on the air in 1919.

The sophistication of radio equipment and the number of amateur operators grew rapidly. One of these amateurs was Frank Conrad, an engineer in Pittsburgh with particularly sophisticated equipment, thanks to his technical background, and with the call sign 8XK.

When Conrad began to transmit music played from phonograph records he got so many individual questions and requests, that he announced he would broadcast on a regular schedule. The response was so positive that the local merchant who was selling him the records agreed to supply them for free if Conrad would mention his store on the air.

A local department store learned about the popularity of this program and started advertising radio receivers not to be used for point to point "ham" radio, but for listening to Conrad. Then the manufacturer of the radio receivers, Westinghouse, which happened to be located in Pittsburgh, heard what was going on. They decided to build a broadcast station at their plant and operate it every night with an advertised program. They thought it would increase the sales of their receivers and be good publicity for their brand name.

On 27 October 1920 they were granted the very first US broadcasting license to operate the station with the call sign KDKA. It was just like a regular ham license, but given to a corporation rather than an individual. The concept of the commercial broadcast station did not exist yet, but it soon would.

On 2 November 1920, presidential election returns (Warren Harding vs. James Cox) were telephoned from the office of the Pittsburgh Post to KDKA. Someone from the Westinghouse information office read them into a microphone; in between, music from a phonograph was played into the microphone. Large numbers of people tuned in. Harding won the election, and modern radio broadcasting was born.

~Internet

The Theory and Practice of GPS

GPS is one of the most fantastic utilities ever devised by man. GPS will figure in history alongside the development of the sea-going chronometer. This device enabled seafarers to plot their course to an accuracy that greatly encouraged maritime activity, and led to the migration explosion of the nineteenth century. GPS will affect mankind in the same way. There are myriad applications that will benefit us individually and collectively.

The global positioning system is a satellite-based navigation system consisting of a network of 24 orbiting satellites that are eleven thousand nautical miles in space and in six different orbital paths. The satellites are constantly moving, making two complete orbits around the Earth in just less than 24 hours. If you do the math, that's about 2.6 kilometres per second. That's really moving!

The GPS satellites are referred to as NAVSTAR satellites. Of course, no GPS introduction would be complete without learning the really neat stuff about the satellites too! The first GPS satellite was launched way back in February, 1978.

Each satellite weighs approximately 1 tonne and is about 5 metres across with the solar panels extended. Transmitter power is only 50 watts, or less!
Each satellite transmits on three frequencies. Civilian GPS uses the 'L1' frequency of 1575.42 MHz.
Each satellite is expected to last approximately 10 years. Replacements are constantly being built and launched into orbit. The satellite orbits are roughly 25,000 kilometres from the earth's centre, or 20,000 kms above the earth's surface.

The orbital paths of these satellites take them between roughly 60 degrees North and 60 degrees South latitudes. What this means is you can receive satellite signals anywhere in the world, at any time. As you move closer to the poles (on your next North Pole or Antarctic expedition!), you will still pick up the GPS satellites. They just won't be directly overhead anymore. This may affect the satellite geometry and accuracy but only slightly.

One of the biggest benefits over previous land-based navigation systems is GPS works in all weather conditions. No matter what your application is, when you need it the most, when you're most likely to get lost, your GPS receiver will keep right on working, showing right where you are!

You know from your history books that Mr Marconi figured greatly in the understanding of the electro-magnetic energy we know as radio. This technology was applied during the 1920's by the establishment of radio stations, for which you needed a receiver. The same applies for GPS- you only need a rather special radio receiver. Significant advances in radio were bolstered by large sums of money during and after the Second World War (for eavesdropping and communications necessities), and were even more advanced by the need for communications with early satellites and rockets, and general space exploration. The technology to receive radio signals in a small hand-held, from 20,000kms away, is indeed amazing.

So what information does a GPS satellite transmit? The GPS signal contains a 'pseudo-random code', ephemeris (pronounced: ee-fem-er-iss) and almanac data. The pseudo-random code identifies which satellite is transmitting - in other words, an I.D. code. Ephemeris data is constantly transmitted by each satellite and contains important information such as status of the satellite (healthy or unhealthy), current date, and time. Without this part of the message, your GPS receiver would have no idea what the current time and date are. This part of the signal is essential to determining a position.

The almanac data tells the GPS receiver where each GPS satellite should be at any time throughout the day. Each satellite transmits almanac data showing the orbital information for that satellite and for every other satellite in the system.
By now the overall picture of how GPS works should be getting much clearer.
Each satellite transmits a message which essentially says, "I'm satellite #X, my position is currently Y, and this message was sent at time Z." Of course, this is a gross oversimplification, but you get the idea.

Your GPS receiver reads the message and saves the ephemeris and almanac data for continual use. This information can also be used to set (or correct) the clock within the GPS receiver.

Now, to determine your position the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received by the GPS receiver. The time difference tells the GPS receiver how far away that particular satellite is. If we add distance measurements from a few more satellites, we can triangulate our position. This is exactly what a GPS receiver does.
With a minimum of three satellites, your GPS receiver can determine a latitude/longitude position - what's called a 2D position fix.
With four or more satellites, a GPS receiver can determine a 3D position which includes latitude, longitude, and altitude.
By continuously updating your position, a GPS receiver can also accurately provide speed and direction of travel (referred to as 'ground speed' and 'ground track').

Accuracy is a relative term of course. If you want to locate a fishing spot, 10 metres is probably fine. But if you want to determine a survey boundary peg, we might need 2 cms. 10 metres, as it happens is fairly typical of current GPS accuracy (since 1 May 2000).

The first source of position error used to be Selective Availability (or SA), but as of 1 May 2000, this was deliberately cancelled. SA created inaccuracies up to 100 metres in an intentionally-imposed degradation on the accuracy of civilian GPS by the U.S. Department of Defence. The rationale behind SA was to deny hostile military or terrorist organizations the maximum accuracy benefits of GPS. Now that SA is gone, we can look forward to more productive and safer use of GPS.

Other factors will affect accuracy, but may become significant only when looking for accuracies better than 10-15 metres.
These factors are satellite geometry (relative positions of each satellite in the sky, units expressed as DOP), multi-patching (where satellite reception is blocked or reflected by buildings etc), and propagation delay due to atmospheric effects. There will also be internal clock errors. These latter errors will normally have no significance for 10-15 metre users.

Q: Why is acquisition of GNSS (global navigation satellite systems) (GPS) signals generally more difficult than tracking and what are the limiting factors?

A: A fairly good analogy of the difference between GNSS signals acquisition and tracking can be found in the rescue of victims of a sunken ship whose location is not accurately known. The first stage of the rescue attempt typically involves an aircraft flying a search pattern, which hopefully encompasses the location where the ship went down. The second stage involves the use of the human eye from the aircraft above, to detect the location of any victims.

Because the human eye is most sensitive in its relatively small area of central vision, the spotter must scan over a vast expanse of ocean, to locate what might be a tiny spot on the ocean's surface. The numerous whitecaps whipped up by the wind in a rough sea appear as "noise", because they hamper the eye's ability to focus.

The process of searching for a person at sea is analogous to the search required for acquisition of a GNSS signal.

However, once the victim is located (acquired), the spotters must keep the person in sight (tracked) for some period of time during rescue operations. The tracking process is generally much easier than acquisition, as the spotter now knows quite accurately where the person is located.

With the centre of the eye's sophisticated tracking ability, even momentary disappearance of the victim is not a problem, because reliable reacquisition is performed by a search over a smaller area than earlier. The clutter (noise) around it is automatically disregarded by the observer. This type of operation is analogous to tracking a GNSS signal.

The sensitivity for tracking in GPS receivers is generally better (typically about two to five decibels lower in signal power) than for acquisition.

Why does this happen?

When a typical GPS receiver is turned on, the following sequence of operations must occur before the receiver can access the information in a GPS signal and use it to provide a navigation solution:

- Determine which satellites are visible to the antenna.
- Determine the approximate Doppler of each visible satellite.
- Search for the signal in both C/A-code delay and frequency (i.e., Doppler shift).
- Detect a signal and determine its code delay and carrier frequency.
- Track the C/A-code delay and carrier frequency as they change.

Signal Acquisition

The acquisition process consists of Steps 1–4 in the foregoing list. In Steps 1 and 2 the visible satellites and approximate Doppler shifts are usually found using approximate time, approximate receiver position, and almanac data (for satellite position and velocity) — all of which have been previously stored in the receiver. This permits the receiver to establish a frequency search region for each visible satellite, and is similar to establishing the region of ocean to search in the above analogy.

Step 3 requires by far the most computation. The C/A-code search includes correlation with a replica code in the receiver that is precisely time-aligned with the received code.

Alignment of the code is achieved when averaging over a sufficient time period allows the signal-to-noise ratio (SNR) to be built to a usable level. Thus, in addition to the code search, a receiver also needs to search in frequency.

Signal Tracking

Once the cell containing the signal has been detected in Step 4, typical receivers use code and carrier tracking loops in Step 5 to generate error signals that keep the replica and received codes aligned and also keep the receiver tuned to the correct frequency as changes in Doppler occur. However, a discrete approximation to these methods of tracking is to repeatedly compare the values of S in the current signal cell with the values in the eight cells surrounding it.

Although the approximation is somewhat crude, it makes analysis of tracking sensitivity much easier and does not really falsify our understanding. If the maximum value of S in the surrounding cells exceeds that of the central cell, the cell with that maximum value is declared as the new signal cell. In this way, both the code delay and carrier frequency of the received signal can be tracked by repeatedly performing a local search over only N = 9 cells, each local search resulting in a tracking update.

To summarize, with enough processing, no theoretical limit exists for either acquisition or tracking sensitivity. However, because tracking requires examination of only a local code delay and carrier frequency region (and coherent averaging can be used as well over the full length of data bits in legacy L1 GPS signals), tracking can be made more sensitive than acquisition before cost limits (either in hardware or processing time) are reached.

Similar conclusions can be reached for other GNSS signals, even taking into account differences in their characteristics.

Correction techniques for greater accuracy (DGPS)
How accurate is GPS, really? A typical civilian GPS receiver provides 10-15 metre accuracy, depending on number of satellites available, and the geometry of those satellites. More sophisticated GPS receivers, costing $5,000 or more, can not by themselves, provide any better accuracies. To get within a centimetre or two, they must use correctional information and computing, as well as using more sophisticated radio reception techniques.

Similar correctional information is also available for a typical civilian GPS receiver. Then the accuracy can be improved to one or two metres (in some cases under a metre!) through a process known as Differential GPS (DGPS). DGPS employs a second receiver at a fixed location to compute corrections to the GPS satellite measurements.

How are these corrections provided to your GPS receiver?
There are a number of free and subscription services available to provide DGPS corrections.
The Australian Maritime Safety Authority transmit DGPS corrections through marine beacon stations along the Queensland coast (Byron Bay to Weipa), and around Sydney, Melbourne, Adelaide, Perth, Port Hedland and Darwin. These beacons operate in the 283.5 - 325.0 kHz frequency range and are free of charge.

Your only cost to use this service is the purchase of a Beacon capable DGPS Receiver. This receiver will receive both the standard GPS signal and the beacon signal and provide a corrected location based on these two signals. This receiver is then coupled to your GPS receiver via a three-wire connection, which relays the corrections in a standard serial data format called 'RTCM SC-104.'

WAAS provides the GPS receiver with additional satellite ranging to achieve better accuracy and reliability.
This system is NOT available in Australia. It is limited to North America.
Omnistar wide area satellite DGPS signals, covering the whole of Australia and SE Asia. Again, a receiver is purchased, but a license for the ongoing signal is required.

Elevation readings and GPS (How far are we above sea level?)
To combine true elevation readings, and GPS, requires the use of something like the Garmin Dakota 20 , eTrex 30 or GPSMAP 62S. These GPS have a built in altimeter, which can give quite accurate (within 3 metres) height readings.

There are two major factors involved in elevation and GPS.

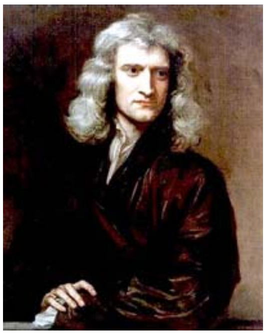
Firstly, what do you mean by elevation? And secondly, is a GPS derived elevation; as good as a GPS derived horizontal position? GPS primarily indicates a surface (horizontal) position based on a mathematical model representing the earth's near-spherical surface. Height or elevation is a different kettle of fish. GPS can give a distance from the centre of the earth, and then by using the radius of the surface model (see above), give you an elevation from the surface model. Let's call this the mathematical elevation. Then you have to ask, does this represent a height above sea level? The answer is no. It may do so in places, but only by accident.

There are tables of the differences around the world, between the mathematical elevation and sea level elevation. [The spherical (more accurately ellipsoidal) models for GPS and sea level are called the spheroid, and the geoid, respectively]. These tables are the result of observations taken over the last few centuries, by surveyors, space scientists and geologists.

Geologists get involved in these observations, because anomalies in gravity strengths often indicate mineralogy. And gravity strengths relate to the behaviour of level determination on the earth's surface.

Because the position solution found by GPS is a mathematical one, and the ranging from the satellites is in the order of 20,000 kms, there is an error bias in the direction of the earths centre. (Because of intersecting lines that may not quite meet.) This of course is the elevation solution.

So if we have an error of 10 metres in the horizontal position, the error in the elevation will be more like 20-30 metres. Your small standard GPS unit usually displays elevation, but you must accept it knowing the above limitations. I can say that it is reasonably sensible. Around the coast of Australia, it will be somewhere around zero, give or take 50 metres. In Toowoomba, it will be about 600 metres. Elsewhere in the world, it may show greater or lesser discrepancy.



Sir Isaac Newton , speculated in the late 1600's that the earth was not a true sphere, and that the distance from pole to pole, was less than the distance across the equator. This estimation, which has become fact through further observation, lays the basis for a true global positioning system. Newton was also the bloke, you remember, who created the theory of gravity when the apple fell from a tree. Newton was preceded by Ptolemy, an Egyptian, in the first century AD. He simply expanded on prior thought from the Greeks, but Ptolemy's are the earliest recorded works on geographical position. The Byzantines and Arabs carried this knowledge through to the modern era, and there were Chinese observations to add to these works.

Ptolemy was the first as far as we know, to describe position as a latitude and longitude. In describing a sphere, and for that matter a circle, we need both a radius and a centre point. So when Newton speculated that the radius to the poles, was shorter than the radius to the equator, he still needed to define the centre point. This, and the exact shape and volume of the earth has exercised many minds.

When the first Sputnik and subsequent satellites were sent in to orbit, scientists were able to measure their paths by range finding. The path of each satellite, varied due to the effects of gravity. From the observations, the centre of mass of the earth has been able to be determined reasonably precisely in relation to a number of points fixed on the earth's surface, and is accepted world wide in the definition described as the World Geodetic System 1984 (or WGS84).
Simplistically, this, along with a radius, and a flattening factor for the squashed polar axis, is the datum of our modern global positioning system. From that centre point, the radius can define the path of a satellite, or the approximate spherical surface of the earth.

Latitude and Longitude
Remember Ptolemy used a latitude and longitude format to describe position. This format simply describes an angle back to the earth's centre from your location. For Brisbane, draw a line to the centre of the earth, and another line from the centre out to the equator. The equator is accepted as a datum worldwide. So we have a Latitude, south of the equator, example S27° 30'.

If you move north about 1.8 km, the latitude reading will change to 27° 29'. That 1' difference (that is one minute of arc, an angular measure, and nothing to do with time) represents 1.8 km (one nautical mile) on the earths' surface.
Handy to remember that.

Let us also draw a line from earth's centre to where the equator meets a vertical line running from the poles through Greenwich, a suburb in South East London. This is the Greenwich meridian, again accepted worldwide as a datum for measurement of Longitude. The angle to the Brisbane line is 153° 03' or thereabouts, depending on where you are in Brisbane. This is E153° 03' Longitude.

Actually, geodisists (scientists who study the measurement of the earth), and the global positioning system (GPS) use the earth's centre, and three axes at right angles to describe a position on the earth's surface. This positioning system is based on a linear measurement of metres from the centre along each of the three axes, describing a set of cartesian coordinates. Latitude and Longitude is a more practical definition for everyday use, and is a derivative calculated from the axis figures.

So the Latitude/Longitude position as described on your little hand-held GPS unit has been made possible, only after long and thoughtful processes spanning thousands of years.

If you intend to relate GPS position to a paper map (such as a street directory, or topographic map), you should at least be aware of different datum positions. Most maps produced prior to 1999, used the Australian Geodetic Datum of either 1966 or 1984.
By default, the GPS you buy from an untrained sales person (especially if you don't specify your intended use), will be set on the WGS84 datum. In this case, the GPS position may differ by 200 metres from the map position.

That is a nuisance when you try to find a fishing spot on a small reef only 20 metres wide!
People have missed a vehicle in the bush, when in fact they were only a few hundred metres away!
All future map production will be on the Australian equivalent of the WGS84 datum (what is called the GDA94).
But the older maps will remain on the newsagent and map-shop shelves for a long time yet.
They will still be useful, so long as you understand the differences.

~Internet

Licence to swill

James Bond has a serious drinking problem, according to new research done in New Zealand.

Pierce Brosnan as James Bond

Scientists with arguably the best job in the world watched 24 Bond films, from 1962's Dr No to 2015's Spectre, logging just how much the British spy drank and what he did while under the influence.

They found not only was Bond ready to drink anything - shaken or stirred - he often takes part in dangerous activities while still under the influence.

"Chronic risks include frequently drinking prior to fights, driving vehicles (including in chases), high-stakes gambling, operating complex machinery or devices, contact with dangerous animals, extreme athletic performance and sex with enemies, sometimes with guns or knives in the bed," said lead author Professor Nick Wilson, from the University of Otago.

Deadly animals Bond fought immediately after drinking alcohol include snakes, tarantulas and even a komodo dragon.

"On one occasion, after drinking at lunch he chased May Day up the Eiffel Tower, jumped on top of a high speed lift, drove a stolen taxi recklessly on footpaths and through the streets of Paris... then jumped about 10 metres from a bridge and through the roof of a barge," the study notes.

Drinking has been a constant feature of the films over the last six decades, with 109 sessions over 24 movies. He meets six of the 11 DSM-5 criteria for having a severe alcohol use disorder, the study claims.

Two particular binges stand out. The first is from Quantum of Solace and saw Bond knock back six Vespers, a gin- and vodka-based cocktail.

"This equates to 24 units of alcohol that would produce a blood alcohol level that is well into the known fatal range," said Prof Wilson.

"But this was low compared to his drinking in one of the James Bond books at 50 units of alcohol in one day, a level of consumption which would kill nearly everyone."

And Bond surely knows he has a problem, says Prof Wilson.

"A medical scan that showed his liver was 'not too good' and a MI6 report on Bond stated, 'alcohol and substance addiction indicated'."

There is some good news though. Bond's use of alcohol as a weapon has declined over time - he's no longer so quick to spike drinks or cut people with broken beer bottles. And he hasn't been seen smoking and drinking at the same time since 2002.

His health also appears to be fine, with no sign of dental erosion from constant champagne breakfasts, and his skin still looks good.

Prof Wilson says next time there's a chance Bond might end up in a helicopter fight, or have to defuse a nuclear weapon, he should stay sober - ditto if there's a possibility he might end up in bed with a sexy assassin.

"Bond should neither allow knives in bed nor hide guns under pillows," the researchers say.

And M needs to stop offering him drinks in workplace settings, the study says, and instead get him more field support.

"This may reduce his need to take excessive individual responsibility for mission success, and lessen his drive to pursue missions when off duty (i.e., as a rogue agent) and personal vendettas".

The study was published in the Medical Journal of Australia.

~Internet

21 Stupid Challenges

Sure, you're bored, but how do you prove that you're really, really bored?

See if you can fit in your fridge.

Start talking to people in other stalls at a public bathroom. See if you can start a conversation.

Get a grocery clerk to sell you one single grape... ...or go to a drive through and try to order one French fry.

Catch a falling leaf. This is particularly hard if it's not the middle of autumn.

Balance the light switch between on and off.

Try to lick your elbow.

If you can't, take a selfie of yourself trying to lick your elbow.

Attempt to play a game on a mobile device using your elbows. Do not do this immediately after licking them.

Have a conversation using only song lyrics.

Say supercalifragilisticexpialidocious backwards.

Say "Irish wristwatch" 5 times fast.

Try and drink a bottle of water without using your hands.

Eat a whole plate of spaghetti with a spoon.

Type your full name with your nose.

Get on a bus, stand in the aisle, and don't hold on to anything. See if you can keep your balance without falling over.

Go to the mall and try to ride up on the down escalator or down on the up escalator.

Try to get from your belly onto your feet without using your hands.

Don't say "like" for a whole day.

Attempt to eat a taco while looking sexy. Have your friend be the judge.

Try to read this list upside down.

10 Things Artificial Intelligence Can't Do

1. Answer The Ultimate Question of life the Universe and everything
Alan Turing discovered the first limitation on Artificial Intelligence; it can't answer everything. Way back in the 1930s he solved a famous mathematical puzzle called the Entscheidungsproblem. The puzzle asks if there is a universal problem solver that can solve any question you throw at it. Turing invented a Universal Machine – we now call this a computer – then asked what would happen if it ran every possible program, would that answer every problem? The answer is no. Amazingly, running every possible computer program – even an infinite number of them – does not solve every possible problem. For the mathematically inclined amongst you, this is because there are different types of infinity. Computers work with the countable type while mapping problems to solutions are part of a large infinity, called the continuum.

2. Solve Annoying Interview Puzzles
Perhaps you don't want your AI to solve everything, just do some useful things such as calculate your expenses and play chess. A Russian mathematician called Yuri Matiyasevich used Turing's theory to show computers can't even solve simple interview puzzles. You've probably encountered these: Mary has some marbles and gives half to Sam and a third to Angela, how many marbles did Mary have if… Solving these types of problems with an algorithm is known as Hilbert's 10th problem and in 1982 Matiyasevich prove there is no general way to solve these sorts of problem.

3. Write Bug-Free Software
Another area that is difficult for Artificial Intelligences is finding bugs in software. Don't get me wrong, artificial intelligence may be a big help in looking for patterns that might suggest there is a bug but a little-known theory by Gordon Rice extends Turing's original proof to show computer programs can't know anything interesting about another computer program. So an AI can't know if a computer program is bug-free, whether it will blue screen or whether it will give you an out of memory error. Indeed, one computer program cannot tell you anything non-trivial about another and since AIs are, at their heart, nothing more than computer programs they can't help you write bug-free software.

4. Write software
The software we use in our daily lives contains bugs, but is still useful. We know computers can't find all bugs, but why can't they write useful software for us? Fred Brooks explained in The Mythical Man Month that writing software involves understanding the essential complexity of the real world and turning that into rules. John Searle's Chinese Room argument says AI does not have the human faculty of understanding. Artificial Intelligences can't write complex software because they don't 'understand'.

5. Make Moral Choices
Malcolm Gladwell points out in his book Blink that people make instantaneous moral choices and then analyse them after the fact to fit the rules. The choices appear to be emotional, not analytical. Artificial Intelligence only uses rules. A theory by Kurt Gödel says that any time you have a system with formal rules there will be problems those rules can't answer – the system will be incomplete. So although computers can obey the law – and we had better hurry up and program them all with Isaac Asimov's three laws of robotics – they can't deal with new situations.

6. Predict the Future of our Universe

There's a growing view in the scientific community that our Universe might be a computer and we live in a simulation. We shoot probes out into space and simple equations predict their path. Perhaps this is because the Universe is an enormous computer and uses these same equations. But we can test this using the Bell experiment. When we test our Universe to see if it follows a pre-defined set of rules we find it doesn't. The particles in our Universe don't know what they will do in advance - there are no hidden variables controlling them - they behave randomly. Computers follow a strict program with no randomness allowed so an AI can't model our Universe and predict its future.

7. Win the Imitation Game
Alan Turing asked how we could tell a machine was intelligent given there is no definition of intelligence. His proposal was to put the supposedly intelligent machine in a locked room and ask it questions. If the machine could fool you into thinking it was human, then it was effectively intelligent. This is known as the Turing test. There's an easy way to beat the AI, ask it one of the impossible interview questions I mentioned earlier. We know computers can't solve these. But there's a problem with this idea. Maybe humans can't solve these questions either! Are there any examples of humans solving impossible questions? The answer is yes. In 1986, Andrew Wiles solved Fermat's Last Theorem, a problem a computer cannot solve. It took him nearly 40 years, but a computer could never have solved it. Humans will always beat an AI in the imitation game if you give them long enough.

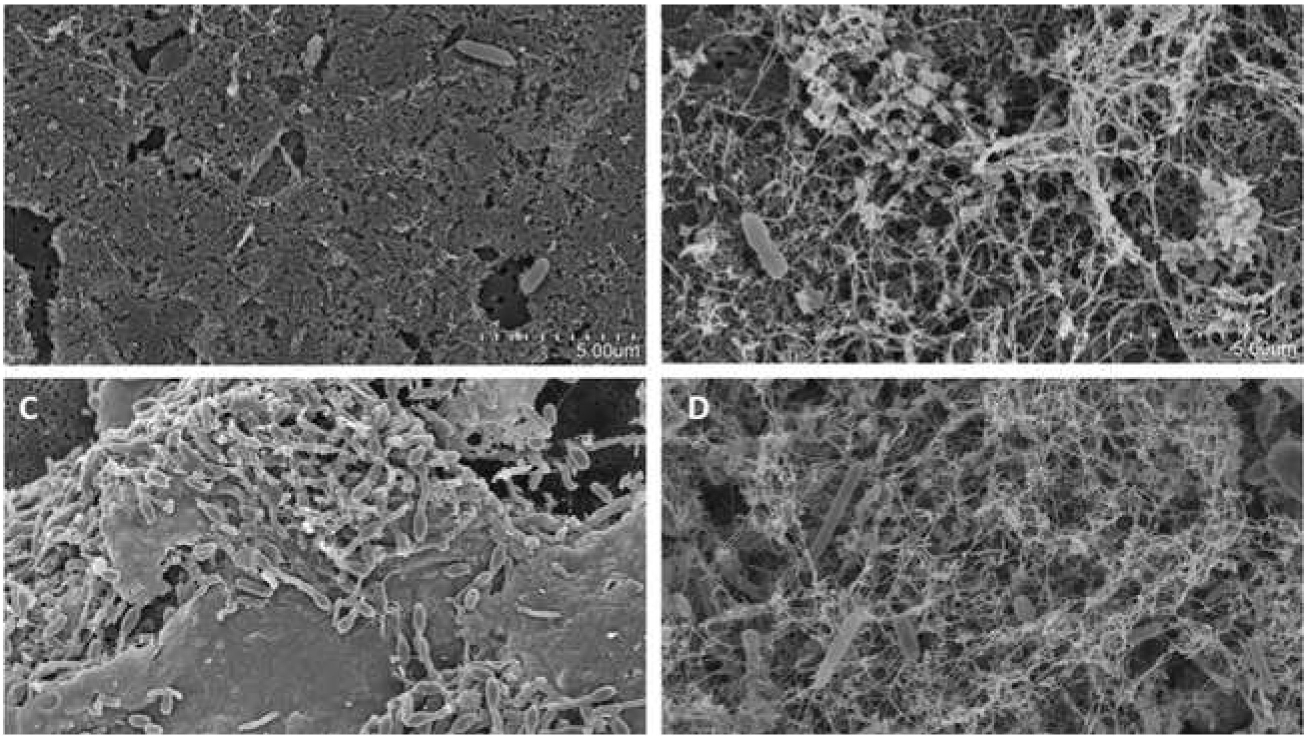
8. Perform Jazz
Artificial Intelligence can't compose music that does not follow rules. Although jazz involves the unwritten exchange of rules between musicians as they play, musicians can evolve those rules and break them at will. Computers can't break the rules so their music will always be formulaic. Roger Penrose has demonstrated non-computable mathematical puzzles and I am proposing music is a similar non-computable puzzle. Humans solve it when they make music. It is quite hard to tell the difference between human and computer music, but there is always a difference.

9. Invent
Humans invent things, compose music and prove mathematical theorems. Roger Penrose & J.R Lucas argue Artificial Intelligence can only follow the rules. Humans, on the other hand, step out of the box and create genuine innovation.

10. Exercise Free Will
AI based on digital computers must follow the rules of its program. Those rules are deterministic and therefore don't allow for any free will. A theorem proposed by Conway and Kochen suggests the fundamental particles in our Universe do have free will and humans tap into this underlying free will so that their actions are not predetermined. Will we be able to use this fact to give our machines free will? I believe we will, but when we do so, they will no longer be AI they will be Real I.

Your Coffee Machine Is a Breeding Ground for Caffeine-Resistant Bacteria

Caffeine's natural antibacterial properties are no match for these hardy colonizers.



Scanning electron microscope images of drip tray samples taken, clockwise from top-left, after four, eight, 14, and 21 days

When you're waiting for your morning coffee to finish brewing, the last thing you probably want to think about is all the bacteria that's living inside your machine.

A team of researchers set out to examine the bacterial communities that grow in the drip trays of pod-based coffee machines (they chose Nespresso due to its popularity and standardization across machines).

Studies have shown that caffeine has natural antibacterial properties, so it stands to reason that your coffee maker is the *last* place you'd expect to find a diverse microbial community.

Instead, they found that, not only is all the extra coffee that doesn't make it into your cup a great environment for rapid bacterial growth, but that the most prevalent bacteria actually thrived off the caffeine.

In other words, there's still bacteria to be found in your coffee maker's drip tray—it just happens to be the coffee-loving kind.

Their research was published in *Scientific Report*, an open access journal from the publishers of *Nature.*

"This is the first systematic analysis of the microbial diversity associated to coffee machines," the researchers claimed.

The team sampled the drip trays from ten different machines, and then monitored the bacterial colonization of a new Nespresso.

After two months, the more general pioneering bacteria gave way to a community composed primarily of "coffee-adapted" bacteria.

One of the two most frequent subfamilies of bacteria found in the machines were Pseudomonas—"which is also one of the few reported examples of a caffeine-degrading bacterium" according to the researchers (caffeine degradation is the process of breaking down, or removing, the presence of caffeine biologically without solvents).

The researchers suggest that there's a good reason for studying this sort of thing, besides grossing you out next time you go to dump your office machine's drip pan: the coffee-happy bacteria "may represent a promising tool for biological coffee decaffeination processes and for environmental caffeine decontamination."

In other words, we could learn a thing or two from these hardy colonizers.

But hey, maybe clean your machine out every now and then. *With soap.*

~Internet

What Is Uranium?

Uranium is a radioactive element discovered by the German chemist Martin Klaproth in 1789, which he decided to name after Uranus for some reason. Uranium has an atomic number of 92, which means that it has 92 protons in its nucleus. It is surprisingly common in nature, with the World Nuclear Association reporting that it is "found in most rocks" in small quantities (about 2 to 4 parts per million). This makes it about as common as tin in the Earth's crust, and about 40 times more common than silver. It also occurs in seawater and can be extracted for use. Originally, uranium was formed by supernovas and its slow radioactive decay (Uranium-238, the most common uranium isotope, has a half-life of 4.5 billion years) is the main source of heat in Earth's core.

What's so special about uranium?

In 1938, physicists Otto Hahn and Fritz Strassman discovered something unique about uranium: when uranium was bombarded with neutrons, it would split into two nearly equal parts—a process called nuclear fission. Soon after, it was discovered that nuclear fission can produce a cascading effect: firing a neutron into the nucleus of a uranium isotope splits the nucleus of the uranium isotope in two, which releases heat but also knocks a couple of neutrons loose. If those neutrons go on to split other uranium atoms, this creates a "fission chain reaction" and when this happens millions of times, it can create a lot of heat from relatively small amounts of uranium.

How is Uranium used?

When most people hear uranium, they think nuclear weapons. Indeed, uranium was the critical component the two nuclear bombs dropped on Japan during World War II, but the type of uranium used for these bombs was highly enriched. In nature, uranium ore consists of about 99.3 percent uranium-238 isotopes and .7 percent uranium-235 isotopes, and the difference between the two uranium isotopes consists of the number of neutrons in the nucleus: 146 neutrons and 143 neutrons, respectively. While this might sound inconsequential, it means that U-238 cannot sustain nuclear fission reactions, but U-235 can. Yet because U-235 is found in such small amounts in naturally occurring Uranium ore, its percentage needs to be increased so that it can be used to power nuclear reactors and create nuclear weapons.

To power a nuclear reactor for energy, U-235 needs to be enriched to about 3 to 5 percent. When this uranium undergoes a fission chain reaction, it boils water to generate steam, which spins a turbine to power a generator and produce electricity. The uranium-235 used for bombs, on the other hand, needs to be enriched to about 90 percent—when uranium is this enriched, it only takes a very small amount to produce a huge result. The bomb that levelled Hiroshima contained about 140 pounds of enriched uranium, but only two percent of it underwent fission (just under three pounds)–still, it produced a blast equivalent to 15 kilotons of TNT.

Uranium and Politics

Even though uranium is abundant on Earth, who gets to enrich the stuff is the subject of intense political debate. This is currently at the centre of the United States beef with Iran, which was enriching uranium to about 20 percent, not enough for a bomb, but more than enough for a nuclear reactor. The 2015 nuclear deal with Iran calls for the country to decrease its stockpile of low-enriched uranium by 98 percent, not produce uranium-235 enriched above 3.7 percent, and repurpose the facility it was building to create weapons grade Plutonium from naturally occurring uranium.

The production of uranium was also at the centre of an agreement struck between the Russian atomic energy agency and a Canadian company called Uranium One in 2013. The agreement gave the Russian agency a majority stake in the company, whose mining operations in Utah and Wyoming accounted for 20 percent of the uranium production capacity in the United States (which is not the same thing as owning 20 percent of the existing uranium in the United States). There was concern that Hillary Clinton had conflicts of interest when signing off on the deal as Secretary of State.

Uranium also has significant environmental implications. According to the Argonne National Laboratory, nuclear energy plants powered by uranium reactions accounted for "90 percent of all carbon emissions averted between 1981 and 1994." On the other hand, this energy supply also produces small amounts of highly-radioactive nuclear waste, which needs to be totally isolated in storage to avoid severe health and environmental problems.

This information probably isn't crucial to 99 percent of the population's day-to-day existence. But for those select few who should be thinking about responsible uses of nuclear power on the reg, there's no more excuses for not knowing about one of the world's most abundant elements.

~Internet

CHILL OUT

For many people, summer means BBQs, beach cricket and dips in the pool.
But there are days when that harsh summer sun isn't quite so fun and cranking up the air-con at home seems like your only option.

We've all been there – those times when you just want to turn your house into a freezer and forget about the energy bill next quarter. But it's important to remember that high energy use associated with cooling houses in summer contributes to greenhouse gas emissions and global warming.

Check out these 10 tips that will keep you and your house cool, save you money, and help you be kind to the earth:

1. Close your blinds
Keep your blinds closed, especially on north and west-facing windows, to significantly cool your home. Better yet, invest in some block-out curtains to shield your home from that harsh summer sun.

2. Block the heat
Stopping heat getting into your house in the first place means spending less on cooling. Shade windows and walls using external coverings, like blinds, awnings or large potted plants. Plant deciduous trees that cast shade over your home in summer, but still let the sun shine through in winter. If you can, invest in window tinting and top up your ceiling insulation – it'll help keep the warmth in winter, too.

3. Just 1 oC more
If you must use your air-conditioner, set the thermostat to between 24-27oC, or as high as you feel comfortable with. Increasing your thermostat by just 1oC in warm weather can reduce the running cost of your appliance by about 10 per cent.

If you're looking to upgrade your air-conditioner, pick one with a high energy-star rating and do your research to ensure you choose the right type of air-conditioner for your home.

4. Adjust ceiling fans
Sometimes you might feel like ceiling fans just push the hot air around your home rather than cool it down. Well you're not wrong – fans that aren't rotating counter-clockwise may be doing just that!

Set your ceiling fans to rotate counter-clockwise in summer to pull hot air toward the ceiling and clockwise in winter to push it down. Ceiling fans can also be used complement other cooling types, so checking they rotate in the correct direction can make a world of difference to the temperature of your home.

5. Close doors and seal gaps
Close doors to rooms you aren't using to keep cool air where you need it most. Seal gaps around doors and windows, and use draught excluders to ensure the cool air can't escape.

Note: evaporative air-conditioners will be more effective if you open some doors and windows to increase air flow through the home.

6. Hang out in the evening
Closing your windows and staying inside may be a great idea during the day, but when it gets cooler in the evening you may want to open your house up to cool your home naturally – just make sure you lock up overnight!

Cooking dinner in the backyard or at the park may be a cooler alternative to being in a steamy kitchen too, so make the most of a cool breeze when you can.

7. Chill out, not chill on
Sip icy-cold drinks, apply a damp cloth to your neck and other pressure points on your body, or have a cold shower to cool your body without needing to switch the air-conditioner on.

8. Hack a fan
No air-con? No worries! A cleverly-positioned bowl of ice is all you need to turn a fan into a cold mist machine. Place a shallow bowl or pan of ice in front of a fan for an icy-cool breeze that won't break the bank.

9. Choose cotton
Cotton fabrics are super breathable and help cool your body. Wear light, loose clothing made of breathable fabrics like cotton, and fit your bed with cotton sheets.

10. Change your light bulbs
If you're having trouble cooling your home and can't work out why, incandescent light bulbs might be to blame. These light bulbs were phased out in Australia years ago, but many homes still use them. They produce a lot of heat, so switching to energy-saving bulbs can help cool your home and save heaps on energy costs – that's a win-win!

~Internet

Why Do Electrolytic Capacitors Explode?

If you want to know why the electrolytic capacitor explodes, first you have to know what the electrolytic capacitor is. An electrolytic capacitor is a kind of capacitance, the metal foil is the positive electrode (aluminium or tantalum), and the oxide film (aluminium oxide or tantalum oxide), which is closely attached to the metal, is the dielectric. The cathode consists of conductive material, electrolyte (which can be liquid or solid) and other materials. Because electrolyte is the main part of the cathode, the electrolytic capacitor is hence named. At the same time, the capacitance of the electrolytic capacitor cannot be connected wrongly.

Why Do Electrolytic Capacitors Explode?

Tantalum electrolytic capacitor mainly consists of sintering solid, foil winding solid, sintering liquid, and so on. The sintered solids account for more than 95% of the current production, which are mainly composed of non-metallic sealed resin.

The aluminium electrolytic capacitor can be divided into four types:

The lead type aluminium electrolytic capacitor;
The horn type aluminium electrolytic capacitor;
The bolted aluminium electrolytic capacitor;
Solid aluminium electrolytic capacitor.

The possible reasons for the capacitor explosion are as follows:

The breakdown of the internal components of the capacitor is mainly due to the poor manufacturing process.

The damage to the shell insulation by the capacitor.
The high voltage side of the capacitor is made of thin steel sheet, and the edge will be uneven with the burr or bent seriously if the manufacturing process is poor, then the tip of which is prone to generate corona that cause the breakdown of oil, the expansion of the case and the drop of oil. In addition, when the cover is closed, the internal insulation will burn and produce oil and gas that make the voltage drop greatly and damage if the welding time is too long.

Poor sealing and oil leakage.
The insulation resistance is reduced due to the poor sealing of the assembly casing. Or the oil surface dropped because of the oil spill that resulting in the extreme shell direction discharge or component breakdown.

The belly and the inside dissociation.
Due to the internal corona, breakdown discharge and serious dissociation, the starting free voltage of the element is reduced to the working electric field intensity under the action of over voltage, which causes the physical, chemical and electrical effects to accelerate the aging and decomposition of the insulation that will produce gas and form a vicious circle, and later the pressure of the case is increased and the drum exploded.

A capacitor explodes with an electric charge.
All capacitors with rated voltages are forbidden to be charged. Each time the capacitor bank recloses, the capacitor must be discharged for 3min after the switch is disconnected. Otherwise, the voltage polarity of the closing moment may be caused by the opposite polarity of the residual charge on the capacitor.

In addition, it may be caused by high temperature, poor ventilation, high operating voltage, excessive voltage harmonic component or operating over voltage, etc.

~Internet

NEVARC Nets

40M Net

Monday, Wednesday and Fridays
10am Local time (East coast)
7.095 MHz LSB
Hosted by Ron VK3AHR
Using club call VK3ANE

80M Net

Wednesday 20:30 Local time
3.622 MHz LSB
Hosted by Ron VK3AHR
Using the club call VK3ANE

2M Nets

Monday at 2000 local time on
VK3RWO repeater
146.975 MHz

NEVARC CLUB PROFILE

History
The North East Victoria Amateur Radio Club (NEVARC) formed in 2014.
As of the 7th August 2014, Incorporated, Registered Incorporation number A0061589C.
NEVARC is an affiliated club of the Wireless Institute of Australia.

Meetings
Meetings details are on the club website, check for latest scheduled details.
Meetings held at the Belviour Guides Hall, 6 Silva Drive West Wodonga.

VK3ANE NETS

HF
7.095 MHz Monday, Wednesday, Friday - 10am Local time
3.622 MHz Wednesday - 8.30pm Local time

VHF
VK3RWO Repeater 146.975 MHz – Monday - 8pm Local time
All nets are hosted by Ron Hanel VK3AHR using the club callsign VK3ANE

Benefits
To provide the opportunity for Amateur Radio Operators and Short Wave Listeners to enhance their hobby through interaction with other Amateur Radio Operators and Short Wave Listeners. Free technology and related presentations, sponsored construction activities, discounted (and sometimes free) equipment, network of likeminded radio and electronics enthusiasts. Excellent club facilities and environment, ample car parking.

Website: **www.nevarc.org.au**

Postal: **NEVARC Secretary**
PO Box 69
Wahgunyah Vic 3683
